PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-181530
(43)Date of publication of application : 28.06.1994

(51)Int.Cl. H04N 5/232
H04N 5/335

(21)Application number : 04-352358
(22)Date of filing : 11.12.1992

(71)Applicant : CANON INC
(72)Inventor : SUZUKI MASAHARU
KATO TAKASHI
AZUSAZAWA KATSUMI

(54) SOLID-STATE IMAGE PICKUP CAMERA

(57)Abstract:
PURPOSE: To improve picture quality and to reduce cost by reading out the picture data of a solid-state image pickup element along geometric deformation due to the geometric distortion of an image generated by an image pickup zoom lens and executing distortion aberration correction.
CONSTITUTION: When a focal length information obtained by a focal position detecting circuit is included within the distortion aberration correcting range of the image pickup zoom lens, a variable SW1 is turned on and a signal generated from a CCD 10 is outputted to an amplifier 6. A distortion aberration correcting circuit formed from the amplifier 6 up to an interpolation circuit 12 is driven, distortion averration correction is executed based on the signal outputted from the CCD 10 and address information outputted from an address storing circuit 11 and a corrected signal is outputted to a video signal processing circuit 13. When the focal length information is outside the range, the SW1 is turned off and the signal of the CCD 10 is directly sent to the circuit 13, which generates and outputs a video signal. When a zooming mechanism is driven, focal length information is newly detected and the operation is executed. Thereby the allowable value of distortion of the zoom lens can be improved and the size and price of the lens can be reduced.

LEGAL STATUS

[Date of request for examination]	18.06.1997
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	2925871
[Date of registration]	07.05.1999
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

CLAIMS

[Claim(s)]

[Claim 1] The image pick-up zoom lens which concentrates distortion aberration only on some image pick-up positions, and is formed, The solid state image sensor which carries out photo electric conversion of the image by which image formation is carried out with this image pick-up zoom lens, When it is detected by said detection means that the image pick-up position of a detection means to detect the image pick-up position of said image pick-up zoom lens, and said image pick-up zoom lens at the time of photography is in the large position of distortion aberration The solid-state image pick-up camera equipped with an amendment means to amend the geometric distortion of the image produced with this image pick-up zoom lens by reading the image data of said solid state image sensor based on geometric deformation.

[Claim 2] The solid-state image pick-up camera characterized by to establish the control means switched in the time of zooming actuation not having the above amended in the solid-state image pick-up camera which amends the geometric distortion of the image which was equipped with the image pick-up zoom lens and the solid state image sensor which carries out photo electric conversion of the image by which image formation is carried out with this image pick-up zoom lens, and was produced with said image pick-up zoom lens by reading the image data of said solid state image sensor based on geometric deformation at the time of zooming actuation.

[Claim 3] A control means is a solid-state image pick-up camera according to claim 2 characterized by being a means to be made not to perform amendment actuation of

geometric distortion at the time of zooming actuation.
[Claim 4] A control means is a solid-state image pick-up camera according to claim 2 characterized by being a means to perform amendment actuation of geometric distortion using this zooming rate information at the time of zooming actuation.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to amelioration of the solid-state image pick-up camera which used the solid state image sensor as optoelectric transducers, such as a still video.
[0002]
[Description of the Prior Art] Conventionally, in this kind of solid-state image pick-up camera, the aberration amendment of an image pick-up zoom lens and the amendment of the aberration (namely, distortion aberration) which produces especially geometric deformation, or signal chromatic aberration to be used were performed severely.
[0003] In the case of the camera using the camera tube, it is possible by controlling the locus of a deviation of the electron beam of the camera tube to amend electrically the aberration produced with an image pick-up zoom lens.
[0004]
[Problem(s) to be Solved by the Invention] However, although the approach of amending aberration by reading the pixel signal of a solid state image sensor, and interpolating geometric distortion produced with the image pick-up lens in accordance with the geometric deformation is proposed if it is in a solid-state image pick-up camera [when using a zoom lens for an image pick-up lens] When signal processing performed aberration amendment in each image pick-up position, computational complexity and computation time huge for signal processing, and a large-scale digital disposal circuit were needed, and it was not general at extent currently examined in the field of the poles for [which needs a high-definition image in current] broadcasting stations part.
[0005] As mentioned above, with the solid-state image pick-up camera which used the conventional zoom lens, since it was difficult to amend this kind simply at cheap cost, in order to make it not need amendment by itself, the problem of the cost jump by enlargement, the increment in lens number of sheets, increase of weight, use of special glass, etc. had been accompanied by the image pick-up zoom lens.
[0006] Next, another technical problem which invention tends to solve is explained.

[0007] Conventionally, by reading geometric ****** produced with the image pick-up lens as a pixel signal of a solid state image sensor in accordance with the geometric deformation, and interpolating this, it consists of JP,2-252375,A so that aberration amendment may be performed.
[0008] However, in the above-mentioned conventional example, when a zoom lens was used for an image pick-up lens and the inside of zooming also always tended to amend geometric ****** in the same approach, said amendment did not fulfill demand to zooming, but it had the trouble that an output image became unnatural.
[0009] Moreover, although it is possible by restricting a zoom rate to making an output image natural, if it does in this way, the new problem that zooming time amount becomes late will arise.
[0010] (The purpose of invention) The 1st purpose of this invention has good image quality, and it is offering the solid-state image pick-up camera which can be made into what has cost cheap also in circuit scale as well as an image pick-up zoom lens.
[0011] The 2nd purpose of this invention is offering the solid-state image pick-up camera which can make an output image natural while making a zoom rate quick.
[0012]
[Means for Solving the Problem] The image pick-up zoom lens which this invention concentrates distortion aberration only on some image pick-up positions, and is formed, When it is detected by said detection means that the image pick-up position of a detection means to detect the image pick-up position of this image pick-up zoom lens, and said image pick-up zoom lens at the time of photography is in the large position of distortion aberration An amendment means to amend the geometric distortion of the image produced with this image pick-up zoom lens by reading the image data of said solid state image sensor based on geometric deformation is established. Concentrate distortion aberration only on some image pick-up positions at the time of an optical design, form an image pick-up zoom lens, and when the image pick-up position of the image pick-up zoom lens at the time of photography is in said distortion aberration In accordance with this geometric deformation, the image data of a solid state image sensor is read for the geometric distortion of the image produced with said image pick-up zoom lens, and it is made to perform distortion aberration amendment.
[0013] Moreover, this invention establishes the control means switched in the time of zooming actuation not having geometric distortion amended, and it is made not to perform amendment actuation of geometric distortion, or it is made to perform amendment actuation of geometric distortion at the time of zooming actuation at the time of zooming actuation using this zooming rate information.
[0014]
[Example] Hereafter, this invention is explained to a detail based on the example of illustration.
[0015] Drawing 1 is drawing showing the optical-character ability of the image pick-up

zoom lens in the 1st example of this invention, and a common image pick-up zoom lens, respectively.

[0016] Drawing 1 (b) is a thing describing the distortion aberration of a common zoom lens, a wide angle side is large and distortion aberration has generated the looking-far side in the minus side at the plus side.

[0017] In order to design a zoom lens, satisfying the conditions of small, lightweight, and a compact, generally making small distortion aberration in a wide angle and looking-far both ends will design a wide angle and the amount of distortion aberration in a tele edge from a very difficult thing so that it may become the almost same amount and may distribute. Therefore, the absolute magnitude of distortion aberration does not become small. However, the large parts of distortion aberration are a wide angle edge and near a tele edge, and the interband is changing almost in monotone and they understand that aberration is not so large for it.

[0018] For this reason, in this 1st example, it is designing in order to make only some photography positions concentrate distortion aberration at the time of an optical design as shown in drawing 1 (a). He considers as the almost same amount of distortion aberration by the wide angle edge and the tele edge as mentioned above, and is trying for the distortion aberration in a middle focal distance to specifically change in monotone.

[0019] And by detecting the image pick-up position of an image pick-up zoom lens at the time of photography, and interpolating the geometric distortion of the image produced with this image pick-up zoom lens by reading the image data of a solid state image sensor in accordance with this geometric deformation, when it is judged as near [where the distortion aberration this image pick-up position is beforehand remembered to be by the storage section is large] an image pick-up position, aberration tends to be amended and it is going to acquire image quality without distortion aberration.

[0020] That is, in this 1st example, image pick-up BOJISHON which carries out distortion aberration amendment is assumed beforehand. The image pick-up position of the zoom lens under current photography is detected at the time of photography so that it may design and mention later in consideration of this at the time of an optical design, and only when amendment is required, it is (in this example). It makes it possible to acquire the image quality which was excellent even if it computed one [at a time] the signal of the pixel of the scanning line in which near a wide angle edge and near a tele edge have geometric deformation using the pixel data of the multi-line which performs distortion aberration amendment, it amended the aberration produced with the image pick-up zoom lens and it used the comparatively cheap lens.

[0021] Drawing 2 is the block diagram showing the outline configuration of the solid-state image pick-up camera possessing an image pick-up zoom lens with the above optical-character ability.

[0022] There are the photo-electric-conversion section of CCD10 whose 1 is a solid

state image sensor (image sensors), and 2 with an example of an image pattern, and they are formed on the photo-electric-conversion section 1. As for the are recording section of CCD10, and 4, 3 is [a charge pattern and 5] shift registers.
[0023] The above CCD 10 is formed with the photo-electric-conversion section 1 mentioned above, the are recording section 3, and a shift register 5.
[0024] As for amplifier and 7, a switch for the instruction of CPU16 which mentions the signal from CCD10 later to distribute 17, and 6 are [a sample hold (S/H) circuit and 8] an analog / digital (A/D) converter. 9 is the Rhine memory and has the capacity which memorizes the output from CCD10 by several lines.
[0025] 11 is an address store circuit, it divided the address information for read-out from the Rhine memory 9 into two kinds, the case of a wide angle edge, and the case of a tele edge, has memorized it beforehand, and has the work which is the need and to which data (the amount information of distortion aberration amendments) are sent out by the way (outputting address information). 16 is CPU which manages advance of this system, when giving ON of whether to make distortion aberration amendment actuation perform, and the information on OFF to a switch 17 (SW1) and making distortion aberration amendment actuation perform from the current focal distance information on an image pick-up zoom lens, chooses the amount information of distortion aberration amendments in a wide-angle edge or a tele edge through said address store circuit 11, and sends out the data in the Rhine memory 9.
[0026] It is the video signal with which an interpolation circuit and 13 are outputted for 12 and a synchronizing signal addition circuit and 15 are outputted for a video signal processing circuit and 14 from the above-mentioned video signal processing circuit 13.
[0027] In addition, although actuation of each above circuit is controlled by the timing control circuit, this control circuit, the control signal, etc. have omitted illustration for simplification.
[0028] Drawing 3 is the organization chart showing the image pick-up zoom lens and focal distance detecting element of the above-mentioned solid-state image pick-up camera.
[0029] In drawing 3 , 3 group lens (compensator lens) for 1 group lens for focuses in 71 (focal lens), 2 group lens (BARIETA lens) in which 72 has a zooming operation, and 73 to amend a focal location, and 74 are 4 group lenses with an image formation operation, and an image pick-up zoom lens is constituted by these.
[0030] The position transducer which detects the location of the BARIETA lens 72 in which 75 has a zooming operation, and 76 are focal distance detectors which compute a focal distance from the positional information (positional information of the BARIETA lens 72) from this position transducer 75, and send out this focal distance information to CPU16.
[0031] Drawing 4 is a flow chart which shows actuation of the solid-state image pick-up camera in the 1st example of this invention, and is explained according to this

below.
[Step 91] Photography actuation is started.
[Step 92] Focal distance information is detected through the focal location detector 76, and current focal distance information is acquired.
[Step 93] The above-mentioned focal distance information distinguishes whether it is distortion aberration amendment within the limits near the wide angle edge decided beforehand or near a tele edge. And if it is distortion aberration amendment within the limits, it progresses to step 94, otherwise, it progresses to step 95.
[Step 94] Since the focal distance information on a current image pick-up zoom lens (in detail BARIETA lens 72) is distortion aberration amendment within the limits, a variable SW1 is turned ON. Thereby, a switch SW1 turns on and the signal from CCD10 is connected to an amplifier 6 side.
[Step 95] Since the focal distance information on a current image pick-up zoom lens is outside a distortion aberration assistant Masanori enclosure, a variable SW1 is turned OFF. Thereby, a switch SW1 turns off and the signal from CCD10 is connected to the direct video signal processing circuit 13 side.
[Step 96] ON of the above-mentioned variable SW1 and OFF are distinguished, if it is ON, it will progress to step 97, and if it is OFF, it will progress to step 98.
[Step 97] The distortion aberration amendment circuit formed more even in an interpolation circuit 12 from amplifier 6 here is operated, and distortion aberration amendment is performed based on the address information from the signal and the address store circuit 11 from said CCD10 (the detail of the actuation in each of this circuit is mentioned later). And it progresses to step 98.
[Step 98] The video signal processing circuit 13 is operated, a video signal is generated based on the above-mentioned distortion aberration amendment circuit or the signal from CCD10, and a video-signal output is performed.
[Step 99] When it distinguishes whether actuation of a zoom device was made and actuation of a zoom device is made, since it may operate during the above-mentioned operation and the focal distance may be changing from the front condition, focal distance information is newly redetected to step 92 return and here, and actuation after step 93 is performed. On the other hand, if actuation of a zoom device is not made, since the focal distance is not changing, it performs actuation after return and this step 96 to step 96.
[0032] Drawing 5 is an outline diagram for explaining an operation of the above-mentioned image pick-up zoom lens.
[0033] In drawing 5 , 21 is a body side and 22 is an example of a body. 23 is an image pick-up zoom lens which consists of each lens group shown in above-mentioned drawing 3 . 24 is the image surface and 25 is an image.
[0034] With the image pick-up zoom lens 23, image formation of the body 22 of the body side 21 is carried out on the image surface 24, and it serves as an image 25. Above-mentioned CCD10 which is a solid state image sensor will be arranged on the

image surface 24, in order to carry out photo electric conversion of the image 25. The image pick-up zoom lens 23 is set up more greatly than an allowed value usual in distortion (it is hereafter described as distortion), and, for this reason, the image 25 has become what was distorted compared with the body 22 like illustration.

[0035] However, in a lens design, as everyone knows, if a certain aberration value is permitted more greatly, amendment of other aberration becomes easy and the image pick-up zoom lens 23 can aim at miniaturization, reduction of lens number of sheets, use of a cheap glass ingredient, etc.

[0036] In drawing 2 , the image pattern 2 corresponding to the image 25 formed by the image pick-up zoom lens 23 on the photo-electric-conversion section 1 of CD10 has arisen. CCD10 shown in this example is a frame transfer form. That is, the image pattern 2 by which photo electric conversion was carried out in the photo-electric-conversion section 1 is transmitted to the are recording section 3 as a charge pattern 4. And every one line of this charge pattern 4 is read with a shift register 5.

[0037] Drawing 6 is the schematic-diagram type Fig. showing the relation of the pixel of an image and CCD.

[0038] Setting to drawing 6 , 31 is the pixel of CCD10, 321, 322, and 323. It is the 1st, 2nd, and 3rd scanning line, respectively.

[0039] The 1st - the 3rd scanning line 321-323 The first three scanning lines are shown, and although it should be a straight line essentially, it is a curve for distortion. That is, the configuration of these curves is the curved configuration itself produced by distortion when the horizontal line set to the body side 21 of the image pick-up zoom lens 23 carries out image formation to the image surface 24.

[0040] In every one line and one line, 1 pixel of read-out of a charge pattern is performed at a time one by one. In a pixel 31, a lower right pixel is read first, next the pixel of the left figure is read and one line is read first one by one. Then, the pixel signal of the line on one is read from the rightmost pixel, and goes. The 3rd line or subsequent ones is the same.

[0041] In drawing 2 , like, the pixel signal read from the shift register 5 of CCD10 is sent to the direct video signal processing circuit 13, when [which was mentioned above] a switch SW1 is OFF.

[0042] On the other hand, when a switch SW1 is ON, it is outputted to a distortion aberration amendment circuit. That is, after being amplified with amplifier 6, it is held by S/H7, and it is digitized with A/D converter 8 after that, and is sent to the Rhine memory 9. And it memorizes here. Before starting read-out in this Rhine memory 9, the signal for several lines of CCD10 is accumulated. This is for reading a pixel signal according to the curved scanning line, and it is because this scanning line is straddling a part for the pixel of several lines.

[0043] The class of data required for distortion aberration amendment is sent to the address store circuit 11 from CPU16 from the focal distance information on the image pick-up zoom lens 23, and the address store circuit 11 generates the address

information for reading the configuration data of the specified scanning line and reading the pixel signal in the Rhine memory 9 from this. The form which sampled the scanning line directly is sufficient, and the form of the multiplier is [the configuration data of the scanning line may perform suitable related approximation, and] sufficient as them. The configuration data of the scanning line corresponding to these lens conditions are obtained at the time of the design of an image pick-up zoom lens, or the optical measurement after a prototype.

[0044] Since the location of the pixel obtained by CCD10 generally is not in agreement, as for the location of the pixel of the curved scanning line, interpolation processing is needed. Therefore, from the above-mentioned Rhine memory 9, the data for several pixels are read, it is sent to an interpolation circuit 12, and the value of one pixel on the scanning line is computed here.

[0045] Here, the capacity of the Rhine memory 9 is determined as follows.

[0046] The related Fig. of the pixel of the Rhine memory 9 and the scanning line is shown in drawing 7 .

[0047] In drawing 7 , 41 is the pixel of the Rhine memory 9 and supports the pixel 31 of CCD10, and 1 to 1. 42 is the scanning line which curved most. That is, the line of the pixel of the Rhine memory 9 of most many in the scanning line is straddled. 43 is the next scanning line of the scanning line 42 which curved most. 44 and 45 are the pixels of the scanning line 42 which curved most, and the following scanning line 43, respectively. It is necessary to compute the value of pixel data in the location of the pixel 44 of the scanning line 42 which was expressed with the black dot and which curved most, and the pixel 45 of the following scanning line 43.

[0048] 46 shows the size of the Rhine memory 9. The size 46 of the Rhine memory 9 is the capacity which can memorize the data of the pixel 31 of CCD10 which all the values of the pixel 44 of the scanning line 42 which curved most can compute. That is, if required for the line count of the pixel 31 of CCD10 which the scanning line 42 which curved most straddles, the line count which added the line of the circumference which is needed by interpolation processing will serve as the size 46 of the Rhine memory 9. Of course, you may be more than this.

[0049] Calculation of the value of the pixel 44 on the scanning line 42 which curved most is more completely [than the pixel 41 of the Rhine memory 9] computable, if the capacity of only the size 46 of the Rhine memory 9 has the Rhine memory 9.

[0050] Next, when computing the value of the pixel 45 on the following scanning line 43, the pixel data of the lowest line are thrown away from the inside of the Rhine memory 9, and the pixel data of the top line are read into the Rhine memory 9 in the following line which is not yet memorized, for example, drawing 4 . Since it is guaranteed that the pixel data 41 of sufficient Rhine memory 9 for the size 46 of the Rhine memory 9 to compute the value of all the pixels on the scanning line to every scanning line are memorizable, all values are computed also about the pixel 45 on the following scanning line 43. The value of a pixel is completely similarly computed to

other scanning lines.
[0051] If it may be necessary to read new pixel data on the occasion of count of the value of a pixel depending on the configuration of the scanning line, pixel data of two or more lines may have to be read. In response to the signal from the address store circuit 11, a non-illustrated timing control circuit adjusts these. Since the pixel data of every a party must be outputted for every fixed time amount when the final output signal of a solid-state image pick-up camera is a video signal, depending on the case, buffer memory can be further given to the Rhine memory 9 for timing adjustment.
[0052] Next, the interpolation processing performed in an interpolation circuit 12 using drawing 8 is explained.
[0053] Setting to drawing 8 , 51 is the scanning line, 521, and 522. It is the pixel of the scanning line, respectively. 531 Moreover, 532, ..., 535 It is the pixel of the Rhine memory 9.
[0054] When computing the value of a pixel to the scanning line 51, it is the pixel 521,522 of the scanning line. A location is the pixel 531-535 of the Rhine memory 9. Since it differs from a location, it is necessary to calculate a value as a interpolation value. It is the pixel 531-535 of the Rhine memory 9 most simply. It is the value of inside to a recently side pixel The pixel 521 of the scanning line, and 522 It gives as a value. Namely, the pixel 521 of the scanning line and 522 A value is the pixel 534 of the Rhine memory 9, and 537, respectively. It considers as a value. If ADOREZU is decided suitably in the address store circuit 11 in this processing, interpolation processing is performed in the case of read-out from the Rhine memory 9, and the special interpolation circuit 12 can be made unnecessary.
[0055] The approach of other approximation is the approach of computing a interpolation value by linear approximation from 4 pixels of the adjoining Rhine memory 9. Namely, the pixel 521 of the scanning line and 522 Count of a value is the pixel 531 of the Rhine memory 9, 532, 534, and 535, respectively. And 532, 533, 535, and 534 It sends 4 pixels at a time to an interpolation circuit 12, and carries out using linear approximation from them.
[0056] Moreover, there is the "cubic convolution method" as the approach of approximation of a value. This is interpolated soon using a cubic spline curve from the value of a pixel, and the value of 16 pixels of near is needed about 1-pixel count in this case.
[0057] In drawing 2 , the output of an interpolation circuit 12 is sent to the video signal processing circuit 13, and is changed into the signal of a format with which the NTSC signal and the Hi-Vision signal were defined. A synchronizing signal is supplied to the video signal processing circuit 13 from the synchronizing signal addition circuit 14, and a final video signal is formed. The output video signal 15 from the video signal processing circuit 13 is displayed on a monitor according to the whole structure of a system, and is performed [being sent to the processing circuit of the next step, etc. and].

[0058] Next, drawing 9 explains distortion amendment processing.
[0059] 61 is an example of a body. 62 is the image, is obtained by the image pick-up zoom lens, and is carrying out the same configuration as this also for the charge pattern on CCD10. 63 is an image by the output video signal.
[0060] drawing 9 -- setting -- the relation of a mutual scale of three graphic forms -- actually -- **** -- it has drawn exaggeratingly so that it may differ.
[0061] An image 62 is distorted to a body 61 for the distortion of the image pick-up zoom lens 23. However, since aberration amendment is electrically performed like previous statement, it is shown that a pixel [**** / the original body 61 of the image 63 by the output video signal 15] is obtained.
[0062] (The 2nd example) Drawing 10 is drawing showing an example of the optical-character ability of the image pick-up zoom lens used in the 2nd example of this invention.
[0063] Here, the distortion aberration of the image pick-up zoom lens used in this 2nd example is very large at a wide angle edge, it has a tele edge and the amount of aberration almost same in middle, and distortion aberration is changing from middle in monotone also with the focal distance to a tele edge. So, in this example, near a wide angle edge performs distortion aberration amendment.
[0064] Drawing 11 is drawing showing an example of change of the distortion aberration by the photography distance near a wide angle edge, and is the distortion aberration in the photographic subject distance of 3m, and the shortest photography distance (1.2 m) from the left at the time of infinite distance photography.
[0065] Also with the same focal distance, it turns out that fluctuation of the distortion aberration by photography distance is large. Then, let not only focal distance information but photography distance information as follows be the distinction information on distortion aberration amendment in this 2nd example.
[0066] Drawing 12 is the focal distance of the solid-state image pick-up camera in the 2nd example of this invention, and the block diagram of a photography distance detecting element. Since other configurations are the same as that of drawing 2 , it is omitting here.
[0067] In drawing 12 , 1 group lens (focal lens) in which 101 has a focal justification operation, 2 group lens (BARIETA lens) in which 102 has a zooming operation, 3 group lens (compensator lens) in which 103 has an amendment operation of a focal location, and 104 are 4 group lenses with an image formation operation, and an image pick-up zoom lens is formed with this 4 group lens 104 from the focal lens 101.
[0068] It is the photography distance detector which the detector with which 105 detects the location of the BARIETA lens 102, and 106 compute a focal distance from the location of the BARIETA lens 102, and the focal distance detector which sends out focal distance information to CPU16, the detector with which 107 detects the location of the focal lens 101, and 108 compute photography distance from the location of the focal lens 10, and sends out photography distance information to CPU

of 16.
[0069] Drawing 13 is a flow chart which shows actuation of the above-mentioned solid-state image pick-up camera, and is explained according to this below.
[Step 111] Photography actuation is started.
[Step 112] Focal distance detection is performed through the focal location detector 106, and current focal distance information is acquired.
[Step 113] The above-mentioned focal distance information distinguishes whether it is distortion aberration amendment within the limits near [which is decided beforehand] a wide angle edge. And if it is distortion aberration amendment within the limits, it progresses to step 114, otherwise, it progresses to step 115.
[Step 114] Since the focal distance information on a current image pick-up zoom lens (in detail BARIETA lens 102) is distortion aberration amendment within the limits, a variable SW2 is turned ON. Thereby, a switch SW1 turns on and the signal from CCD10 is connected to an amplifier 6 side. And it progresses to step 116.
[Step 115] Since the focal distance information on a current image pick-up zoom lens is outside a distortion aberration assistant Masanori enclosure, a variable SW2 is turned OFF. Thereby, a switch SW1 turns off and the signal from CCD10 is connected to the direct video signal processing circuit 13 side. And it progresses to step 117.
[Step 116] Current photography distance information is detected through the photography distance detector 108, it distinguishes where [of the photography distance zone where this photography distance is decided beforehand next] it corresponds, and this is memorized as a variable SW3. And it progresses to step 117.
[0070] As a variable SW 3= 2, when it is a short distance and is middle distance as a variable SW 3= 1, when it is a long distance, specifically, it memorizes as SW 3= 3 here.
[Step 117] ON of the above-mentioned variable SW2 and OFF are distinguished, and, in ON, it progresses to step 118, and, in OFF, progresses to step 119.
[Step 118] The distortion aberration amendment circuit formed more even in an interpolation circuit 12 from amplifier 6 here is operated, and distortion aberration amendment is progressed to a line and SUITEPPU 119 based on the address information chosen with the signal and photography distance data (signal class of variable SW3) from said CCD10.
[Step 119] The video signal processing circuit 13 is operated here, a video signal is generated based on the above-mentioned distortion aberration amendment circuit or the signal from CCD10, and a video-signal output is performed. And it progresses to step 120.
[Step 120] When it distinguishes whether actuation of a zoom device was made and actuation is made, since a zooming device may operate and the focal distance may be changing after a video-signal output, it returns to step 112, and focal distance information is newly redetected, and actuation after step 113 is performed. Moreover, if the zoom device is not operating, it progresses to step 121.

[step 120] a variable SW2 -- ON (= focal distance distortion aberration amendment within the limits) -- it is -- in addition -- and the focus device is operating -- that distinction is performed, and if it comes out so and is, actuation after this step 116 that progressed to step 116 and was mentioned above will be advanced. On the other hand, if it is conditions other than the above, it will progress to step 117 and actuation after this step 117 will be advanced.

[0071] A photograph is taken by repeating the above actuation.

[0072] It constitutes so that the photography conditions which amend at the time of photography may be beforehand limited to the pole of all photography patterns part at the time of an optical design according to the 1st and 2nd above-mentioned examples. The image pick-up position of the zoom lens under current photography is detected at the time of photography. Only when amendment is required That is, since he is trying to amend the aberration produced with the image pick-up zoom lens only when it is in distortion aberration amendment, it is possible to make small the scale of the digital disposal circuit under photography, and a leeway is given also in the signal-processing capacity under photography. Moreover, there is little lens number of sheets of an image pick-up zoom lens, a compact lightweight design is attained, and a cheaper and small solid-state image pick-up camera is obtained.

[0073] (The 3rd example) Drawing 5 is the outline diagram showing the image pick-up zoom lens in the 3rd example of this invention.

[0074] In drawing 5 , 21 is a body side and 22 is an example of a body. 23 is an image pick-up zoom lens which consists of each lens group shown in above-mentioned drawing 3 . 24 is the image surface and 25 is an image.

[0075] With the image pick-up zoom lens 23, image formation of the body 22 of the body side 21 is carried out on the image surface 24, and it serves as an image 25. CCD216 which is the below-mentioned solid state image sensor will be arranged on the image surface 24, in order to carry out photo electric conversion of the image 25. The image pick-up zoom lens 23 is set up more greatly than an allowed value usual in distortion (it is hereafter described as distortion), and, for this reason, the image 25 has become what was distorted compared with the body 22 like illustration.

[0076] However, in a lens design, as everyone knows, if a certain aberration value is permitted more greatly, amendment of other aberration becomes easy and the image pick-up zoom lens 23 can aim at miniaturization, reduction of lens number of sheets, use of a cheap glass ingredient, etc.

[0077] Drawing 14 is the block diagram showing the outline configuration of the solid-state image pick-up camera equipped with the above-mentioned image pick-up zoom lens.

[0078] The photo-electric-conversion section of CCD216 whose 201 is a solid state image sensor (image sensors), and 202 are examples of an image pattern, and are formed on the photo-electric-conversion section 201. 203 is the are recording section of CCD216, and 204 is a charge pattern. 205 is a shift register and CCD216 is

formed with the above-mentioned photo-electric-conversion section 201, the are recording section 203, and a shift register 205.
[0079] As for amplifier and 207, 206 is [a S/H (S/H) circuit and 208] an analog / digital (A/D) converter. 209 is the Rhine memory and has the capacity which memorizes the output from CCD216 by several figures. 210 is a lens condition signal, this lens condition signal 210 shows the current condition of the image pick-up zoom lens 23, and the information about the condition of a zoom, the condition of a focus, a zoom rate, etc. is included. 211 is an address store circuit and outputs the address information for read-out from the Rhine memory 209. 212 is an interpolation circuit. As for a video signal processing circuit and 214, 213 is [a synchronizing signal addition circuit and 215] output video signals.
[0080] In addition, although actuation of the above component circuit is controlled by the timing control circuit, the control circuit, the control signal, etc. have omitted illustration for simplification.
[0081] Next, actuation is explained.
[0082] In drawing 14 , after the signal of the pixel of CCD216 read from the shift register 205 is amplified with amplifier 206, it is sent to the S/H circuit 207, and it is held here. Furthermore, the output signal of this S/H circuit 207 is digitized with A/D converter 208, is sent to the Rhine memory 209, and is memorized here. Before starting read-out, the signal for several lines of CCD216 is stored in the Rhine memory 209. This is for reading a pixel signal according to the curved scanning line, and it is because this scanning line is straddling a part for the pixel of several lines. If the lens condition signal 210 is inputted into the address store circuit 211, this address store circuit 211 can know the present lens condition.
[0083] ROM (read-only memory) is built in in the above-mentioned address store circuit 211, and the configuration data of the scanning line corresponding to a lens condition are memorized. The form which sampled the scanning line directly is sufficient, and the form of the multiplier is [the configuration data of the scanning line may perform the suitable approximation of function, and] sufficient as them. The configuration data of the scanning line corresponding to these lens conditions are obtained at the time of the design of the image pick-up zoom lens 23, or the optical measurement after a prototype.
[0084] The address store circuit 211 is ****** about the address to read according to the data and the lens condition in said ROM, and for this read the pixel signal in the Rhine memory 209 at the time of a zoom halt. And through Path A, the signal of CCD216 is amended in the video signal processing circuit 213, and this signal is outputted. Since the location of the pixel obtained by CCD216 generally is not in agreement, as for the location of the pixel on the curved scanning line, interpolation processing is needed. Therefore, from the Rhine memory 209, the data for several pixels are read, it is sent to an interpolation circuit 212, and the value of one pixel on the scanning line is computed here.

[0085] Here, drawing 15 is the explanatory view showing distortion amendment processing.
[0086] In drawing 15 , 231 is an example of a body. 232 is the image and is obtained by the image pick-up zoom lens 23. The charge pattern on CCD216 is also carrying out the same configuration as this. 233 is an image by the output video signal 15.
[0087] drawing 15 -- setting -- the relation of a mutual scale of three graphic forms -- actually -- **** -- it has drawn exaggeratingly so that it may differ.
[0088] An image 232 is distorted to a body 231 for the distortion of the image pick-up zoom lens 23. However, since aberration amendment is electrically performed as already stated, it is shown that an image [**** / the original body 231 of the image 233 by the output video signal] is obtained.
[0089] At the time of zoom actuation, as mentioned above, the data for distortion amendment of the image in said ROM data are not used, do not perform interpolation, either, but output the bent image in CCD216 itself according to Path B.
[0090] The flow chart of drawing 16 explains the above distortion amendment actuation.
[Step 241] Photography actuation is started.
[Step 242] ON/OFF of a zoom is judged. And since there is nothing line WA about distortion amendment in ON, it stops at this step. On the other hand, in order to perform distortion amendment in OFF, it progresses to step 243.
[Step 243] A zoom location and a focal location are detected and it progresses to step 244.
[Step 244] The configuration data of the scanning line corresponding to the above-mentioned lens condition are taken out, and it progresses to step 245.
[Step 245] Interpolation processing is performed based on the configuration data of the above-mentioned scanning line, and distortion amendment is performed.
[0091] In addition, although distortion was mentioned as the example as geometric ****** here, you may be other geometric ******.
[0092] Moreover, the image in direct CCD216 may be outputted to the video signal processing circuit 213 by the analog circuit at the time of Zoom ON.
[0093] According to the above example [3rd], in order for the inside of zooming not to perform distortion amendment, simplification of data processing and quick zooming of it become possible.
[0094] (The 4th example) Drawing 17 is a flow chart which shows distortion amendment actuation of the solid-state photography camera concerning the 4th example of this invention, and drawing 18 is the explanatory view of the amount calculation of amendments in step 253 of drawing 17 .
[0095] In focal distance f=Z, the scanning-line configuration data based on the lens condition in that case perform distortion amendment through an interpolation circuit at the time of Zoom OFF.
[0096] However, when it is beforehand found by Z'=Z+v and **t, using the zoom rate

as **t and focal distance Z' is reached [rate] by zooming in v and distortion amendment data-processing time amount, the amendment performs the amount f of amendments in focal distance Z' which is probably changing at the time of Zoom ON when the current focal distance Z is **t Left by zooming (Z') to coincidence.

[0097] It is from step 251 of drawing 17 to step 254 that the actuation at the time of the above zoom ON is shown.

[0098] By performing such control, it is possible to solve the unnaturalness of the image by distortion amendment stopping fulfilling demand to the zoom rate at the time of carrying out zooming, without delaying a zoom rate.

[0099] According to the above example [4th], the inside of zooming becomes possible [obtaining natural image on real time], in order to perform distortion amendment based on a zoom rate.

[0100]

[Effect of the Invention] The image pick-up zoom lens which according to this invention concentrates distortion aberration only on some image pick-up positions, and is formed as more than explained, When it is detected by said detection means that the image pick-up position of a detection means to detect the image pick-up position of this image pick-up zoom lens, and said image pick-up zoom lens at the time of photography is in the large position of distortion aberration An amendment means to amend the geometric distortion of the image produced with this image pick-up zoom lens by reading the image data of said solid state image sensor based on geometric deformation is established. Concentrate distortion aberration only on some image pick-up positions at the time of an optical design, form an image pick-up zoom lens, and when the image pick-up position of the image pick-up zoom lens at the time of photography is in said distortion aberration In accordance with this geometric deformation, the image data of a solid state image sensor is read for the geometric distortion of the image produced with said image pick-up zoom lens, and it is made to perform distortion aberration amendment.

[0101] Therefore, image quality is good and can consider as what has cost cheap also in circuit scale as well as an image pick-up zoom lens.

[0102] Moreover, the control means switched in the time of zooming actuation not having geometric distortion amended is established, and it is made not to perform amendment actuation of geometric distortion, or is made to perform amendment actuation of geometric distortion at the time of zooming actuation at the time of zooming actuation according to this invention using this zooming rate information.

[0103] Therefore, while making a zoom rate quick, it becomes possible to make an output image natural.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the optical-character ability of the image pick-up zoom lens in the 1st example of this invention, and a common image pick-up zoom lens, respectively.

[Drawing 2] It is the block diagram showing the outline configuration of the solid-state image pick-up camera in the 1st example of this invention.

[Drawing 3] It is the organization chart showing the image pick-up zoom lens and focal distance detecting element of a solid-state image pick-up camera of drawing 2 .

[Drawing 4] It is the flow chart which shows actuation of the solid-state image pick-up camera of drawing 2 .

[Drawing 5] It is an outline diagram for explaining an operation of the image pick-up zoom lens of drawing 2 .

[Drawing 6] It is the schematic-diagram type Fig. showing the pixel of CCD of drawing 2 , and the relation of an image.

[Drawing 7] It is drawing showing the pixel of the Rhine memory of drawing 2 , and the relation of the scanning line.

[Drawing 8] It is drawing for explaining the interpolation processing in the interpolation circuit of drawing 2 .

[Drawing 9] It is drawing for explaining the distortion amendment processing in the 1st example of this invention.

[Drawing 10] It is drawing showing an example of the optical-character ability of the image pick-up zoom lens used in the 2nd example of this invention.

[Drawing 11] It is drawing showing an example of change of the distortion aberration by the photography distance near the wide angle edge of the image pick-up zoom lens used in the 2nd example of this invention.

[Drawing 12] It is the organization chart showing each detecting element of the focal distance of the solid-state image pick-up camera in the 2nd example of this invention, and photography distance.

[Drawing 13] It is the flow chart which shows actuation of the solid-state image pick-up camera of drawing 12 .

[Drawing 14] It is the block diagram showing the outline configuration of the solid-state image pick-up camera in the 3rd example of this invention.

[Drawing 15] It is drawing for explaining the distortion amendment processing in the 3rd example of this invention.

[Drawing 16] It is the flow chart which shows distortion amendment actuation of the solid-state image pick-up camera in the 3rd example of this invention.

[Drawing 17] It is the flow chart which shows distortion amendment actuation of the solid-state photography camera concerning the 4th example of this invention.

[Drawing 18] It is the explanatory view of the amount calculation of amendments in

step 253 of drawing 17 .

[Description of Notations]

9,209 Rhine memory

10,216 CCD

11,211 Address store circuit

12,212 Interpolation circuit

13,213 Video signal processing circuit

16 CPU

23 Image Pick-up Zoom Lens

76 Focal Location Detector

108 Photography Distance Detector